U.S. EPA Region 8
Underground Injection Control Program
Record of Decision
Variance From 40 CFR Section 147.2104(d)(4) Well Casing Requirement in the Dewey-Burdock Class III Area Permit

PROJECT BACKGROUND INFORMATION

The Dewey-Burdock Project is located approximately 13 miles north-northwest of Edgemont, South Dakota, in an area encompassing portions of Fall River and Custer counties. The project is an in-situ recovery of uranium operation. The U.S. Environmental Protection Agency (EPA) Underground Injection Control (UIC) Program is proposing to issue a Class III Area Permit under the Safe Drinking Water Act (SDWA) for injection of fluid into the uranium ore zone for the purpose of mobilizing the uranium for production. The wells to be constructed under the Class III Area Permit are subject to a number of well construction requirements, including the requirement at 40 CFR § 147.2104(b)(1), which states that "the owner or operator of a new injection well cased with plastic (PVC, ABS, or others) casings shall (1) not construct a well deeper than 500 feet."

The permit applicant, Powertech (USA) Inc., requests a variance from this requirement due to its plan to use plastic well casing materials and need to construct the wells at depths greater than 500 feet. The request along with supporting justification is included in Section 11.1.1 of Powertech's updated UIC Class III Permit Application dated January 2013, which is attached to this Record of Decision. Key aspects to Powertech's justification, including adequate protection of underground sources of drinking water (USDWs) are discussed here along with EPA's reasons for acceptance.

REGULATORY BACKGROUND FOR VARIANCE REQUEST

EPA Regulations Governing Injection Well Construction Materials in South Dakota

In addition to well construction requirements found at 40 CFR parts 144 and 146, UIC wells regulated by the EPA UIC Direct Implementation program in South Dakota are subject to the EPA requirements found at 40 CFR § 147.2104. One of the requirements in this section states that: "the owner or operator of a new injection well cased with plastic (PVC, ABS, or others) casings shall: (1) Not construct a well deeper than 500 feet." 40 CFR § 147.2104(b)(1). The regulations also provide that "the Regional Administrator may approve alternate casing and cementing practices provided that the owner or operator demonstrates that such practices will adequately protect USDWs." 40 CFR § 147.2104(d)(4). This Record of Decision outlines the rationale for approval of the use of PVC well casing at depths greater than 500 feet.

Request for Variance from Requirement Disallowing the Use of Plastic Casing for Wells Deeper Than 500 Feet

In Section 11.1.1 of the Dewey-Burdock Class III Permit Application, the Permittee requests a variance from the requirement in 40 CFR § 147.2104(b)(1) that plastic well casing materials, including PVC, ABS or others, not be used in new injection wells deeper than 500 feet in the State of South Dakota. The variance is requested pursuant to 40 CFR § 147.2104(d)(4).

BASES FOR VARIANCE REQUEST

The Permittee provided the following bases for the well casing variance request:

1) Collapse pressure calculations and well casing manufacturer specifications indicate that PVC well casing can be used at depths greater than 500 feet considering the site-specific well construction methods (see Section 11.1.1.1).
2) PVC well casing has been used successfully for wells deeper than 500 feet at uranium ISR facilities for many years (see Section 11.1.1.2).
3) PVC well casing is commonly used for other wells in South Dakota deeper than 500 feet (see Section 11.1.1.3).
4) Thermoplastic well casing is the preferred well casing material for ISR facilities due to corrosion resistance. The corrosion resistance of PVC compared to carbon steel well casing is well documented.

5) Each new injection, production and monitor well will be pressure tested to confirm the integrity of the casing prior to being used for ISR operations. This mechanical integrity test will be repeated every 5 years and after any repair where a downhole drill bit or under-reaming tool is used (see Section 11.5).
6) The injection pressure for each injection well will be maintained below the maximum pressure rating of the well casing (see Section 7.2).
7) An extensive excursion monitoring program will be implemented by installing and sampling monitor wells in the perimeter of the production zone and in overlying and underlying hydrogeologic units to detect potential excursions of ISR solutions into USDWs such as would occur with a leaking injection well (see Section 14.2).
8) Injection pressures will be monitored through automated control and data recording systems that will include alarms and automatic controls to detect and control a potential release such as would occur through an injection well casing failure (see Section 14.1).

EPA EVALUATION OF VARIANCE BASES

1. Review of Hydraulic Collapse Pressure Calculations

To ensure that the use of thermoplastic casing will withstand hydrostatic pressure as it increases with depth , Part V, Section D.4 of the Class III Area Permit requires the Permittee to adhere to the requirements in ASTM F480, Standard Specifications for Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80 when specifying well casing and during installation procedures. ASTM F480 states that "the depth at which thermoplastic well casing can be used is a design judgment." There is no depth of installation limit in ASTM F480 except that PVC well casing should be "used under conditions that meet manufacturer's recommendations for its type" and that "the driller shall install the thermoplastic casing in a manner that does not exceed the casing hydraulic collapse resistance."

In accordance with these requirements, the Permittee must ensure that all thermoplastic well casing meets the manufacturer's recommendations for its type and is installed in a manner that does not exceed the hydraulic collapse resistance. The net hydrostatic pressure on the well casing is calculated as the difference between the exterior and interior hydrostatic pressure. The hydrostatic pressure is calculated as the fluid density multiplied by the fluid depth. The Permittee proposes using a cement grout density of 90 lb/ft^3 to fill the borehole-well casing annulus of all injection, production and monitoring wells. Recognizing that until the cement behind the well casing cures, the inside of the well casing will always be full of water (with a density of at least 62.4 lb/ft^3 depending on whether additives are used), and the pressure versus depth gradient will be about 27.6 lb/ft^3 or about 0.2 psi/ft of depth. According to CertainTeed (2011)[1], the hydraulic collapse pressure for SDR 17 PVC well casing is about 224 psi. Therefore, it would take an installation depth much greater than 1,000 feet to exceed this pressure as long as cement grout is used, and the well casing remains full of water until the cement hardens. Both of these conditions will be met in all injection, production and monitoring well casing installations using the procedures required under Part V of the Class III Area Permit. Water will be used to displace the cement and force it upward into the borehole-well casing annulus as required under Part V, Section E.4.e; therefore, the well casing will always be full of water while the cement cures.

2. Evaluation of Current Use of PVC Casing in Wyoming Class III Wells

PVC well casing is presently used in Wyoming in several hundred Class III in-situ uranium recovery wells. The EPA contacted the Wyoming Department of Environmental Quality, Land Quality Division which provided the following information:

- The depth of the deepest Class III well with PVC casing in Wyoming is 1,050 feet. The deepest such well proposed by Powertech in the Dewey-Burdock project area is approximately 900 feet.
- The diameter of the deepest well in Wyoming is 5 inches, with most wells at 4.5 inches. The proposed Powertech well diameter range is between 4.5 and 6 inches.
- The Wyoming PVC type is SDR 17, while the Powertech Standard Dimension Ratio will be no greater than SDR 17.

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[1] *CertainTeed, Selection of PVC Well Casing, Based on Hydraulic Collapse Considerations,* PVC HydraulicCollapseBroch40-37-02C_LR_single.pdf

- The mechanical integrity failure rate for PVC casing in Wyoming was 1.8% of all wells during a four-year period. This is lower than the steel casing failure rate ranging between 2.6% and 6.3%[2] over a minimum four-year period.

These aspects show that many existing PVC Class III injection wells are constructed at depths greater than 500 feet and they have lower mechanical failure rates than steel-cased wells. Mechanical integrity failure avoidance is a primary aspect of protecting USDWs.

3. Current Use of PVC Casing in South Dakota Domestic and Livestock Wells

Precedent has been established in the South Dakota state regulations under ARSD 74:02:04, which supports the use of PVC well casing for other types of wells, including domestic and livestock wells, to depths greater than 500 feet, with some being greater than 1,000 feet. In accordance with ARSD 74:02:04, Powertech will ensure the use of 5-inch PVC well casing that is Schedule 40 or heavier or SDR 17 or heavier. These casing strength requirements are yet another layer of protection for USDWs.

Review of South Dakota State Regulations for Well Construction

South Dakota state regulations under ARSD 74:02:04 also supports the use of PVC well casing for other types of wells to depths greater than 500 feet. For example, Section 36 of ARSD 74:02:04 provides construction requirements for SCH 80 PVC private domestic and noncommercial livestock wells more than 1,000 feet deep.

ARSD 74:02:04, Sections 42 and 43 discuss general well casing requirements. Section 42 says, "Casing materials may be thermoplastic, steel, nonferrous metal, fiberglass, precast curbing, or concrete" but that, "casing may only be used under conditions that meet manufacturer's recommendations and specifications for its type." Section 43 provides thermoplastic casing requirements, including that PVC well casing 5 inches or greater in diameter must have a minimum wall thickness of 0.250 inch. Part V, Section E.2.b requires the Permittee to use well casing of SDR not greater than SDR 17, which will ensure that all PVC well casing 5 inches or greater in diameter has a minimum wall thickness of 0.250 inch. This means that 5-inch PVC well casing will be SCH 40 or heavier or SDR 17 or heavier. Section 43 also requires thermoplastic pipe to conform to ASTM F480. Compliance with the requirements in ASTM F480 is described in Section 11.1.1.1 of the Permit Application.

4. Requirement for Corrosion-Resistance Well Casing

During the ISR process, the injection fluid is ISR lixiviant consisting of wellfield groundwater with carbon dioxide and oxygen added. The carbon dioxide and oxygen mobilize the uranium from the ore deposit into the groundwater. The uranium-bearing lixiviant is pumped to the processing plant, where the uranium is removed using the ion exchange process. The resin beads in the ion exchange column remove the uranium from the fluid phase and release chloride into the fluid. The fluid is pumped back to the wellfield where it is refortified with carbon dioxide and oxygen and used again as lixiviant. Carbon dioxide and oxygen in the lixiviant and the addition of chloride from the ion exchange process increase the corrosivity of the lixiviant injectate. Part V, Section E.1.d of the Class III Permit requires the well casing to be chemically compatible with the injectate and formation fluids. PVC pipe is more resistant and chemically compatible than metal casing to these corrosive constituents in the lixiviant injectate.

5. UIC Class III Permit Requirements for Maintaining Well Integrity

Demonstrating mechanical integrity of injection well casing is important for the protection of USDWs. The Class III Area Permit Part VII, Section C.4 requires that each new injection be pressure tested to confirm the integrity of the casing prior to initiation of injection. Part VII, Section G.1 of the Class III Area Permit requires periodic demonstration that well casing integrity is maintained by running a casing pressure test on active wells every 5 years. Part VI, Section B of the Permit requires demonstration of mechanical integrity after any well workover affecting the well casing or cement.

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[2] Considine TJ, Watson RW, Considine NB, Martin JP. (2013) *Environmental regulation and compliance of Marcellus Shale gas drilling*. Environ Geosci. 2013:20-1:16.

6. Injection Pressure Permit Limit

Under 40 CFR § 146.33(a)(1) injection pressure at the wellhead must be calculated to assure that the pressure in the injection interval during injection does not initiate new fractures or propagate existing fractures in the injection interval. In no case should the injection pressure initiate fractures in the confining zone or cause the migration of injection or formation fluids into a USDW. The fracture pressure is the pressure at which fluid injection is expected to create fractures, or to propagate existing fractures, within the receiving formation. The Maximum Allowable Injection Pressure (MAIP) is the permit limit that the injection pressure must not exceed. The Class III Area Permit sets the MAIP at 90% of the fracture pressure.

In the Dewey Area where the proposed injection intervals are greater than 500 feet deep, the Class III Area Permit allows the Permittee the option of using well casing or casing fittings that have a manufacturer-specified maximum operating pressure below the calculated fracture pressure based on the depth to the ore zone. In cases where the Permittee chooses to use well casing or any well component with a manufacturer-specified maximum operating pressure below 90% of the calculated fracture pressure, the MAIP permit limit will be set at the lowest manufacturer-specified maximum operating pressure. Part V, Section E.2.c and Part V, Sections F.5 and F.6 of the Class III Area Permit require that the MAIP within the wellfield does not exceed the pressure rating of injection well casing.

7. Excursion Monitoring Requirements

The purpose of excursion monitoring is to detect any migration of injected fluids outside of the designated injection interval. Part II, Section D and Part IX, Section C of the Class III Area Permit require an extensive excursion monitoring program implemented by installing and sampling monitoring wells around the wellfield perimeter within the injection interval and in overlying and underlying aquifer units to detect potential excursions of ISR solutions into USDWs such as would occur with a leaking injection well.

8. Automated Monitoring and Data Collection.

Part V, Section K of the Class III Area Permit requires the Permittee to install automated control and data recording systems at the Burdock Central Processing Plant and Dewey Satellite Facility which will provide centralized monitoring and control of the process variables including the flows and pressures of production and injection streams. The systems must include alarms and automatic shutoffs to detect and control a potential release such as would occur through a leaking injection well. The Central Processing Plant and Satellite Facility control rooms will both receive the pressure and flow data transmitted from several critical monitoring locations. This information will provide the plant operators access to instantaneous data on wellfield operating conditions, enabling operators to respond appropriately to unexpected or upset conditions and to direct the wellfield operators to specific locations where immediate attention is needed.

THE EPA REGIONAL ADMINISTRATOR'S APPROVAL OF THE ALTERNATE CASING

The EPA has reviewed the Permittee's request for variance to use PVC casing for injection wells deeper than 500 feet and has determined that the Permittee has demonstrated that USDWs are adequately protected by using the type of casing the Permittee proposes for the injection wells. The Class III Area Permit includes requirements for well construction, well operation, well casing integrity testing and monitoring to verify protection of USDWs during injection activities. The reasons for this determination are:

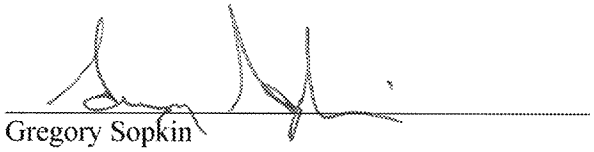
1) Collapse pressure calculations and well casing manufacturer specifications indicate that PVC well casing can be used at depths greater than 500 feet when standard specifications such as those included in ASTM F480 are used for selecting casing materials. The well construction methods required in the Class III Area Permit will assure that the difference between the exterior and interior hydrostatic pressure exerted on the well casing during well construction does not exceed the hydraulic collapse resistance of the casing.
2) PVC well casing has been used successfully for wells deeper than 500 feet at uranium ISR facilities in Wyoming for many years. Class III well integrity failure rates are lower for Wyoming PVC Class III wells than for steel casing.
3) PVC well casing is commonly used for wells in South Dakota deeper than 500 feet. Well construction regulations promulgated by South Dakota include provisions for use of PVC well casing in wells deeper

than 500 feet, specifying that "casing may only be used under conditions that meet manufacturer's recommendations and specifications for its type."

4) Thermoplastic well casing is the preferred well casing material for ISR facilities due to corrosion resistance. The corrosion resistance of PVC compared to carbon steel well casing is well documented.
5) The Class III Area Permit requirements for demonstration of well casing mechanical integrity ensure:
    - that each new injection well be pressure tested to confirm mechanical integrity of the casing prior to being used for ISR operations.
    - confirmation that mechanical integrity is maintained through periodic testing of an active well every 5 years.
    - demonstration of mechanical integrity after any well workover affecting the well casing or cement.
6) Requirements in the Class III Area Permit ensure that the MAIP within the wellfield does not exceed the pressure rating of injection well casing.
7) The Class III Area Permit requires implementation of an extensive excursion monitoring program involving monitoring wells around the wellfield perimeter within the injection interval and in overlying and underlying aquifer units to detect potential excursions of ISR solutions into USDWs such as would occur from a leaking injection well.
8) The Class III Area Permit requires that injection pressures and flow rates must be monitored through automated control and data recording systems that will include alarms and automatic controls to detect and control a potential release such as would occur through an injection well casing failure.

Justification and Conclusion

Based on the foregoing reasons, the EPA has determined that the use of PVC casing for Class III wells at the Dewey-Burdock uranium recovery site provides adequate protection of USDWs. Protection of USDWs is further enhanced through monitoring requirements in the Class III Permit. The fact that PVC casing is successfully used in Wyoming Class III uranium recovery injection wells with a lower failure rate than that of steel casing and in South Dakota wells deeper than 500 feet, further support the adequacy of PVC casing at depth greater than 500 feet. Therefore, considering the above findings, and to accommodate Powertech's plans for constructing PVC cased wells to approximately 900 feet, Powertech's request for alternate casing is hereby approved at the Dewey-Burdock site for depths not to exceed 1,000 feet.



Gregory Sopkin
Regional Administrator